Systems Considerations

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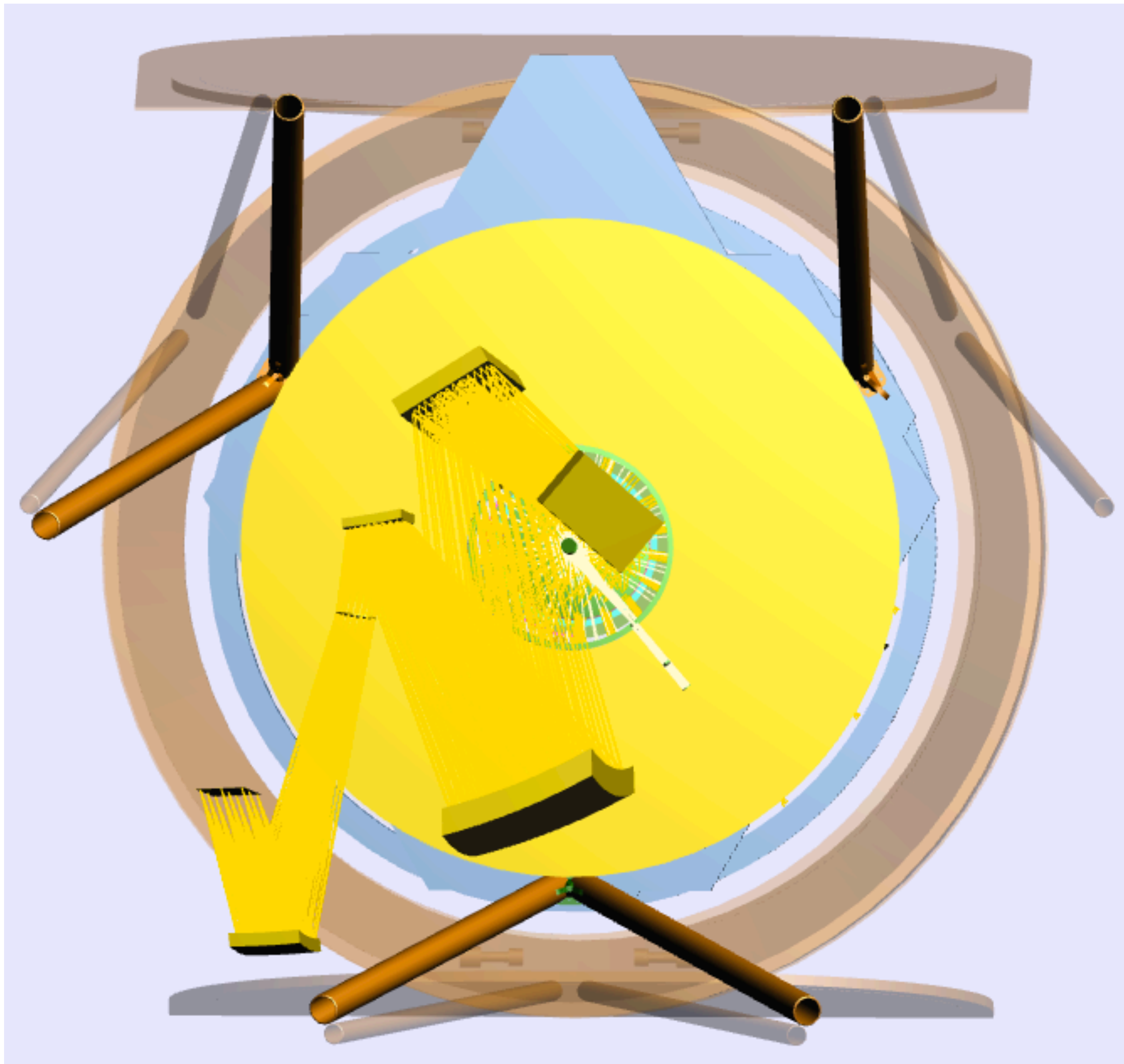
Serviceability Impacts on DRM

- In order to more fully take advantage of the opportunity afforded by the NRO telescope, NASA HQ has requested that the DRM produced by this SDT be an evolvable, serviceable design that allows replacement of both instrument and spacecraft modules.
  - This provides the capability to extend the lifetime of the observatory through replacing spacecraft hardware as it ages and adding new instruments to evolve the design.
- In order to service the observatory, we must fly at a location where we can be serviced
  - Robotic servicing capabilities are being developed for GEO, so we will assess GEO as specified in the charter.
- Past DRMs have had a goal to be as modular as possible providing flexibility during I&T
  - Serviceability takes the next step, adding mechanical and electrical interfaces that can be mated/de-mated on-orbit
  - The servicing interfaces will leverage off of GSFC expertise with HST heritage designs for servicing features such as latches and blind mate connectors

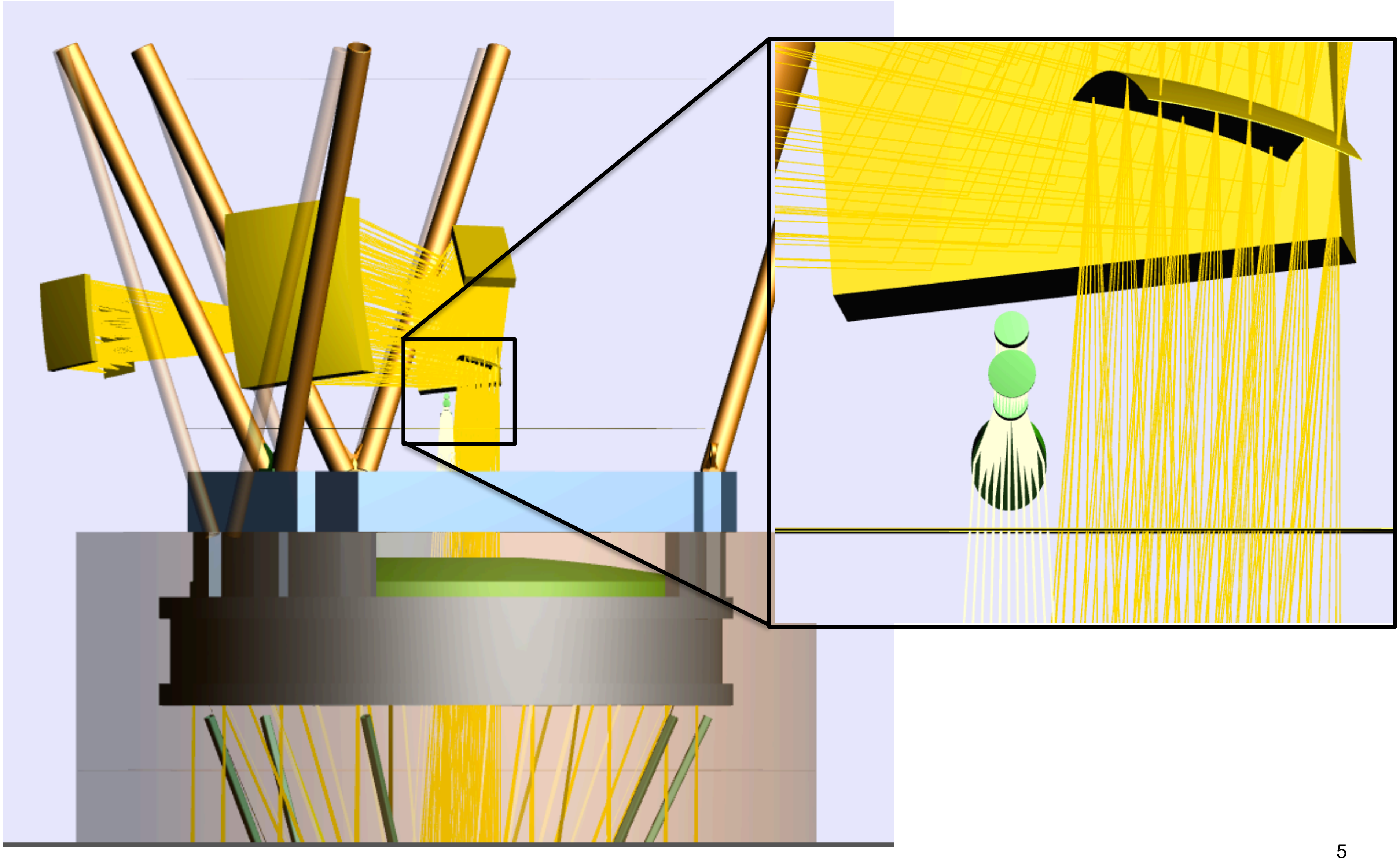
Observatory Configuration Trade

- Currently assessing two options for Observatory configuration
  - Radially serviced instruments
  - Axially serviced instruments
- Both concepts are still in a preliminary conceptual stage.
- Both concepts follow "use as is" guidelines
- Goal is to maintain the same instrument volumes in both configurations
- Packaging of wide field instrument is being worked within the radial concept. The axial concept was developed without the optical ray trace.
- Decision will be based on a number of factors including serviceability and mass (drives cost)
  - Servicing team (RESTORE) is currently assessing servicing of these concepts

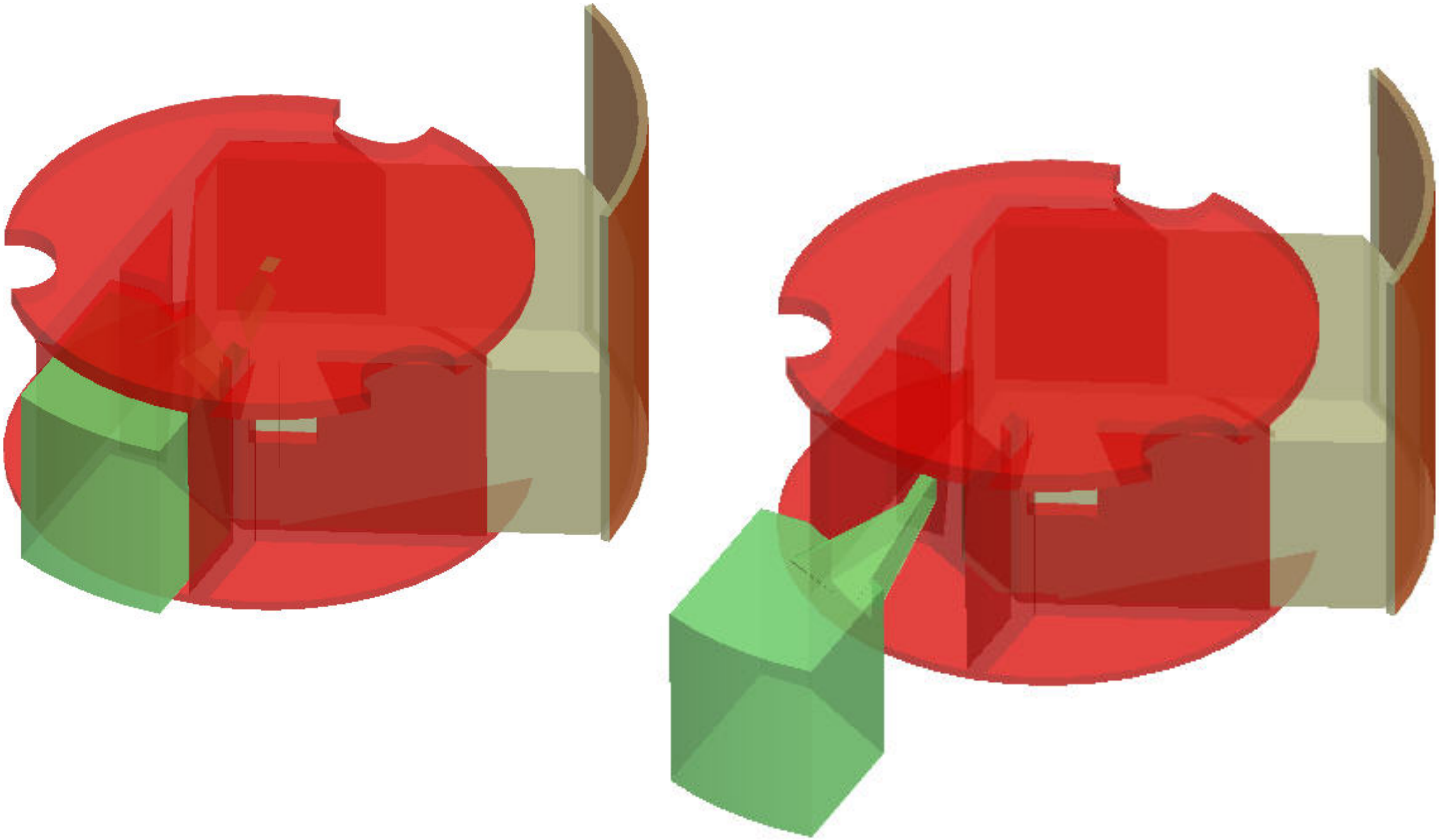
Payload Packaging



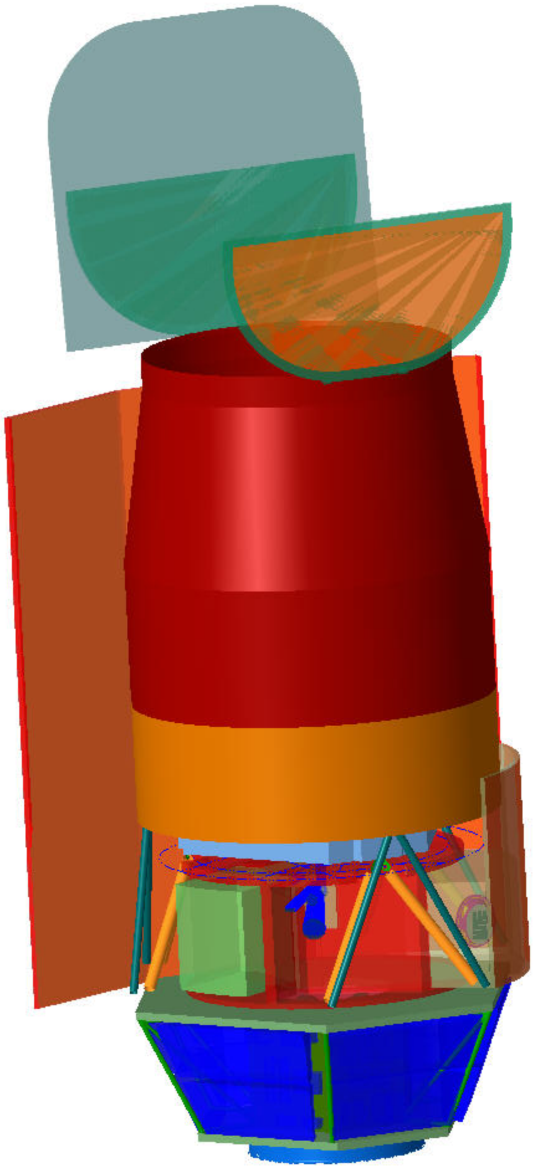
Payload Packaging

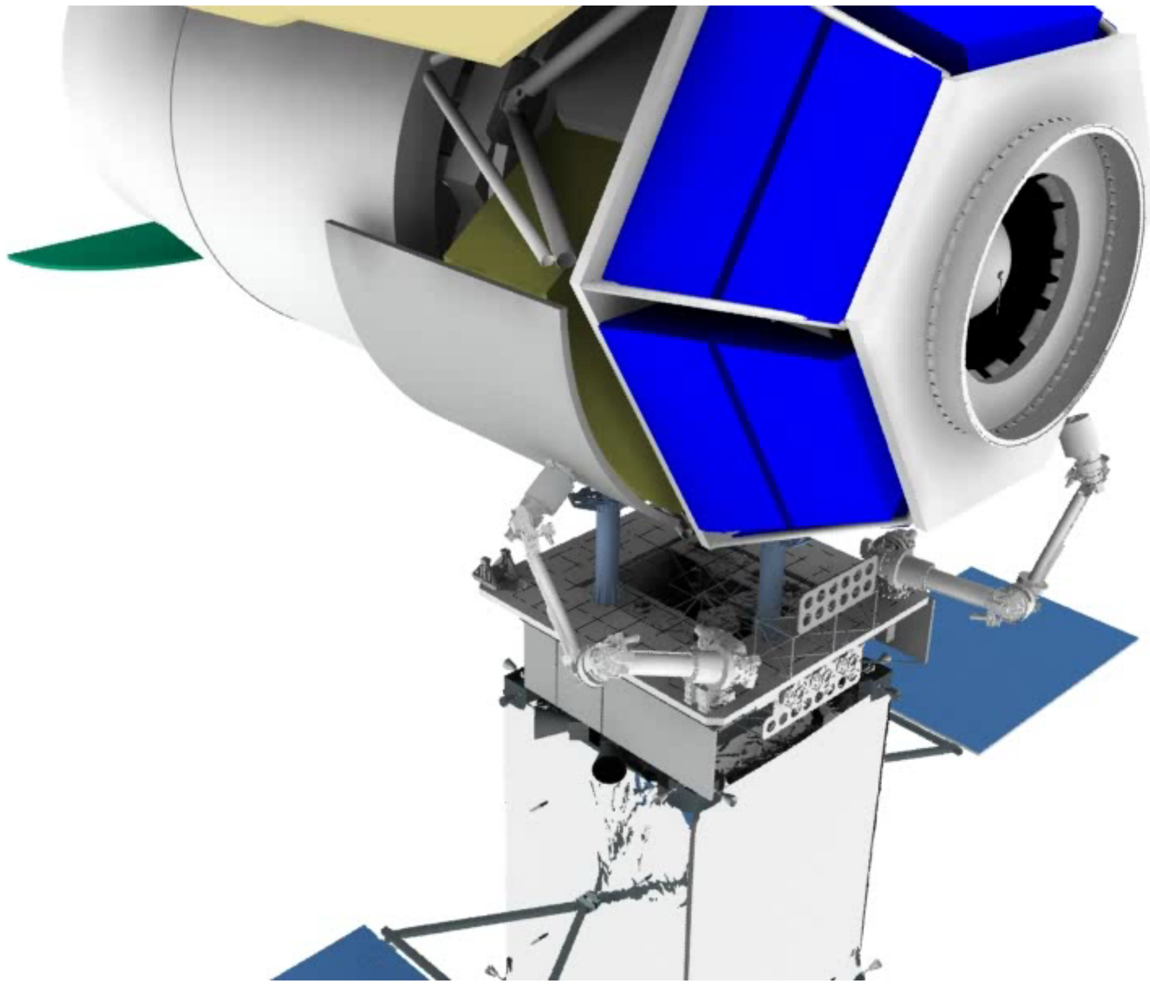


Instrument Carrier

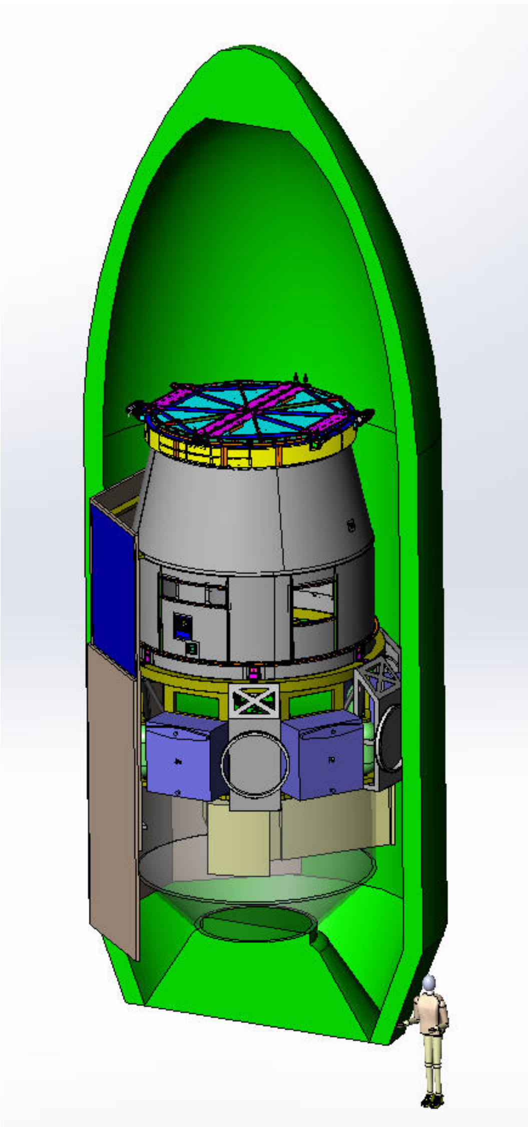


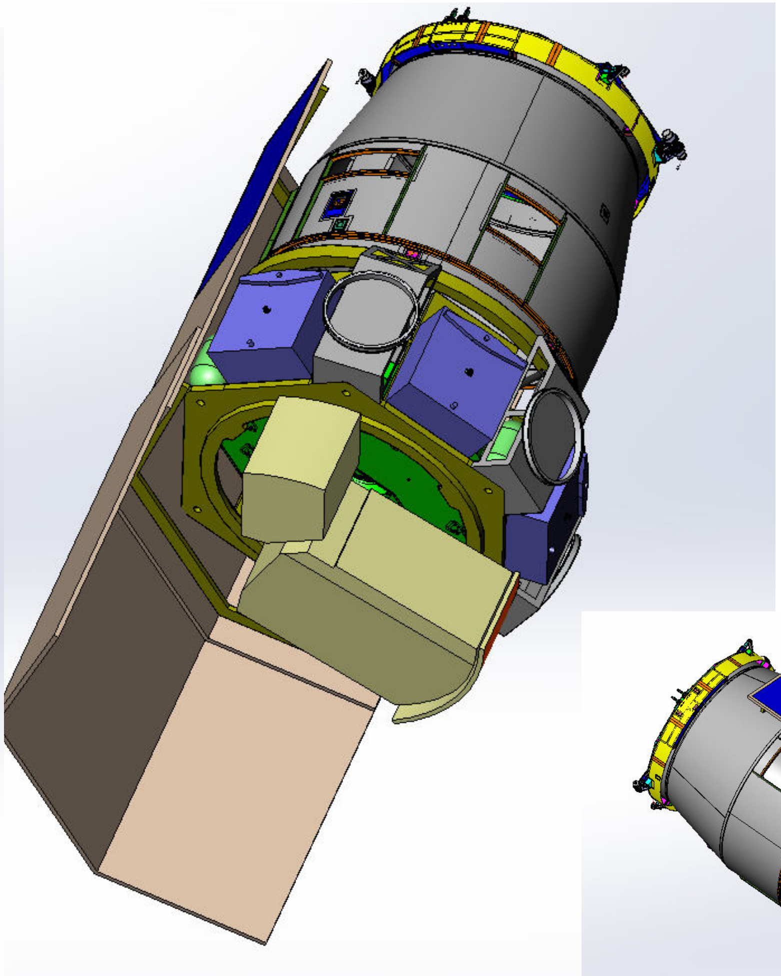
Concept 1

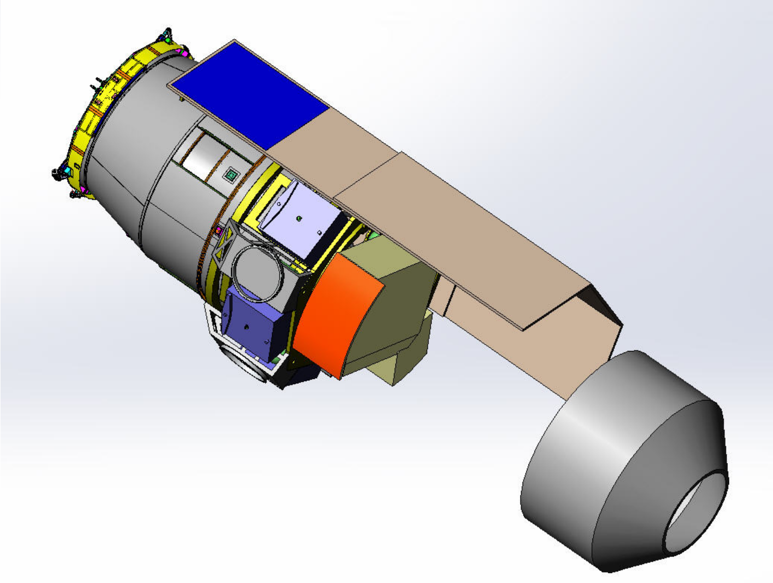




Concept 2





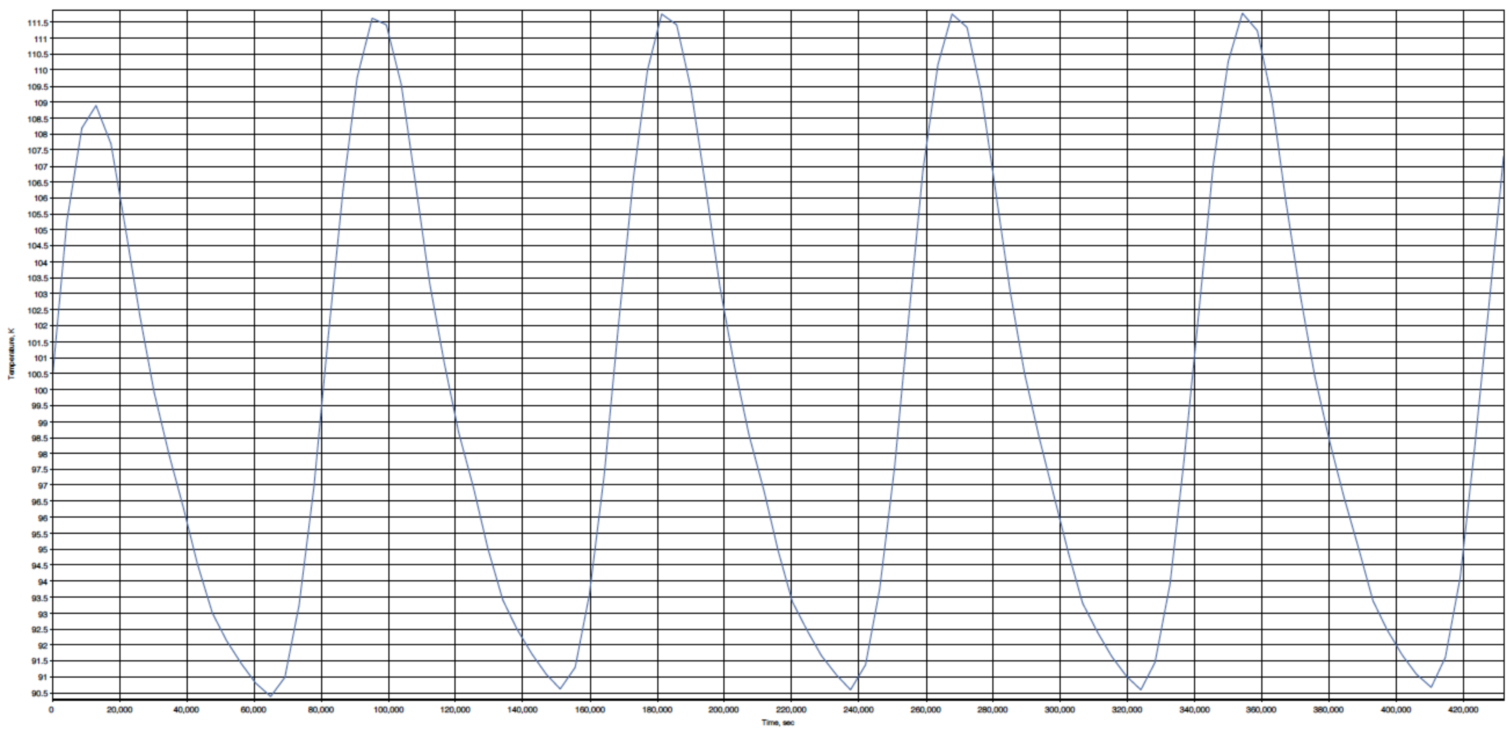


Orbital Considerations

- Both GEO and L2 provide unique benefits and challenges for AFTA-WFIRST
- GEO
  - Telerobotic servicing capability
  - Potentially higher data volumes to the ground with a dedicated ground station than possible from L2.
  - GEO has a more severe radiation environment
    - Understood for electronics, currently assessing required shielding for trapped electron environment for detectors
- L2
  - More thermally stable environment with minimal stray light concerns and access to a large field of regard without the influence of the Earth and Moon.

Thermal Comparisons

- Past designs have used a fixed solar array/sunshield that gives a hot side and cold side. No sun is allowed on the cold side.
- At GEO, the sun will remain on the hot side, but the Earth “walks” around the observatory daily.
- For a white painted radiator of 2.25 m^2, dissipating 3.31 W
  - At L2, the radiator temp is 86 K
  - At GEO, the radiator cycles between 90 K and 112 K at 0 deg. beta angle



Fault Tolerance

- Past DRMs, with the exception of DRM2, have been baselined as 5 year missions and were designed with sufficient consummables (e.g. propellant) for a 10 year life.
- All of these missions were single fault tolerant and were, for the most part, block redundant
  - Exceptions include RWAs (3 for 4) and star trackers (2 for 3)
- DRM2 was scaled back to 3 years in an attempt to minimize the life cycle cost
  - DRM2 had a similar sensitivity to the DRM1 concept but its total science return was less due to the shorter lifetime.
  - The DRM2 concept implemented "selective redundancy" in a few key areas.
  - The SDT and others expressed a desire to explore implementing some of the DRM2 innovations in DRM1 (including redundancy) to extend life to fully meet the NWNH science.
- Independent cost estimate did not realize the savings we anticipated for the DRM2 S/C vs. IDRM

Fault Tolerance with Servicing

- A large serviceable observatory implies the need for some level of redundancy to enable the observatory to be placed into a safe state for servicing.
- However, the orbit location may provide further constraints on the amount of redundancy required
- It seems likely that an observatory in GEO would be required to be single fault tolerant to operating the propulsion system to ensure it maintains its slot on-orbit in the case of a failure.
  - Likely requires redundancy in the C&DH, power, and prop subsystems to ensure this.
- The same argument may be made for L2 if the observatory must be able to reach a servicing location
  - However, the case may be able to be made that the observatory only needs to be in a sun pointing safe mode (thermally safe and power positive) if it can be retrieved from L2